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(54) Applying liquid gaskets to workpieces

(57) A liquid gasket material such as air-curing silicone rubber is applied to a succession of workpieces from a nozzle guided e.g. by a cam (31) over a required path over the work location, the operation of the nozzle being controlled by workpiece sensing means. For simple closed loop paths, the sensing means can detect the presence of previously applied gasket material, and stop the movement of and flow from the nozzle after only a short overlap. If the direction of travel around the loop is reversed between successive workpieces, the starting and stopping points of the nozzle will not progress around the loop, allowing free access to the work location for placement of workpieces. For complicated paths, the flow of material from the nozzle can be switched on serveral times in a closed loop path around the workpiece by a sensor sensing the edges of the workpiece.

FIG.1

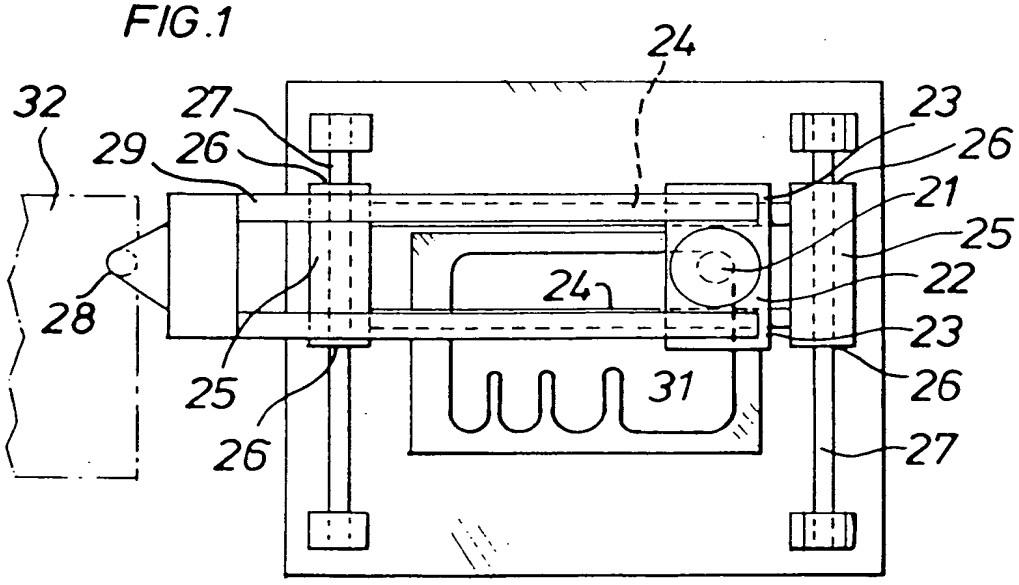

FIG. 2

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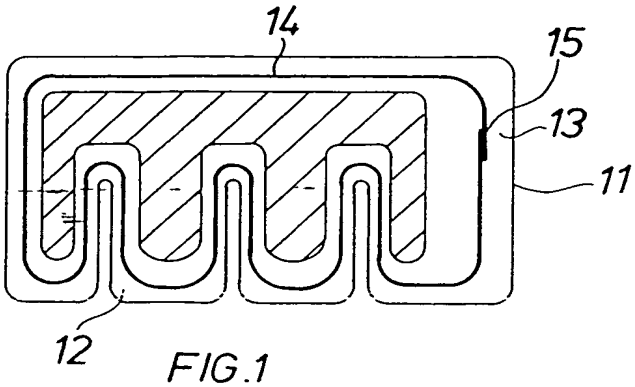

FIG.1

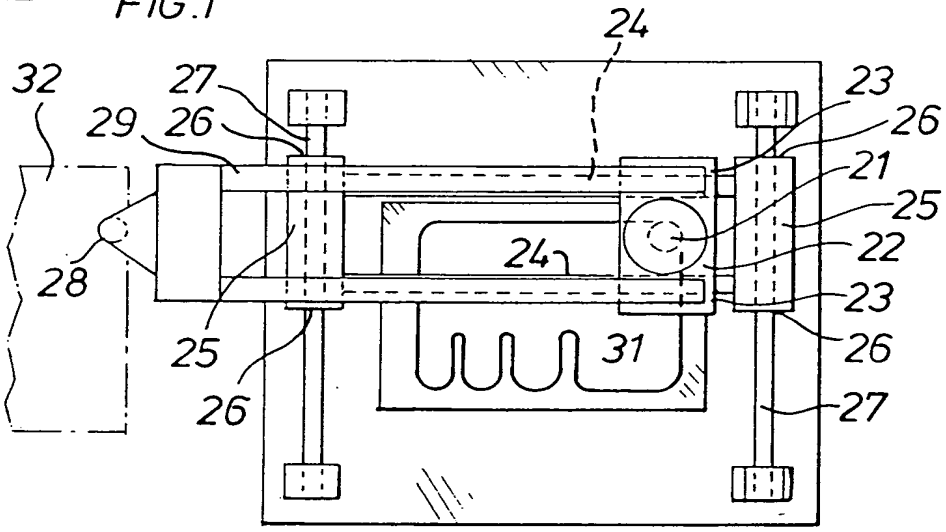

FIG. 2

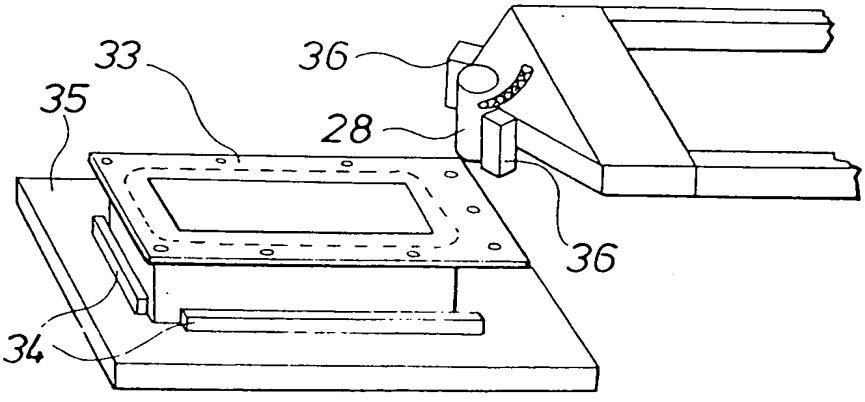

FIG. 3

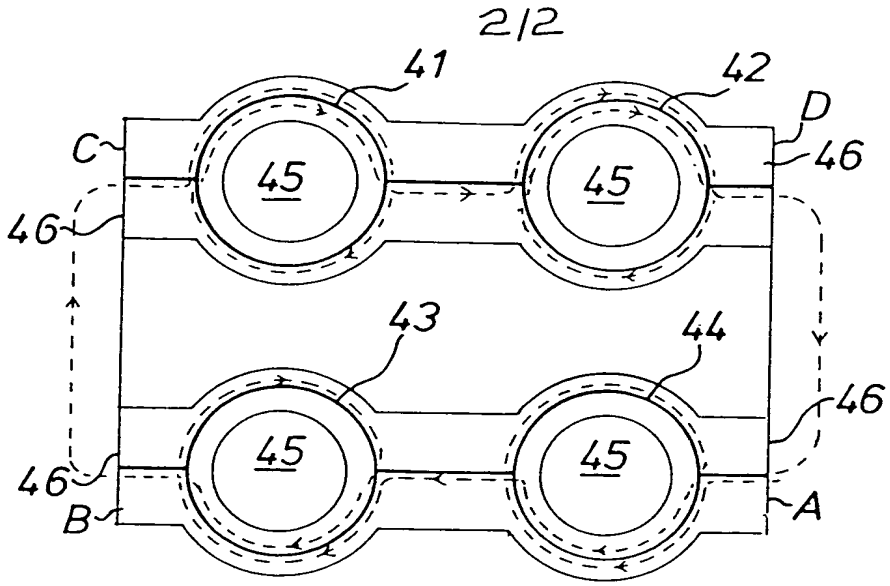
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FIG. 4

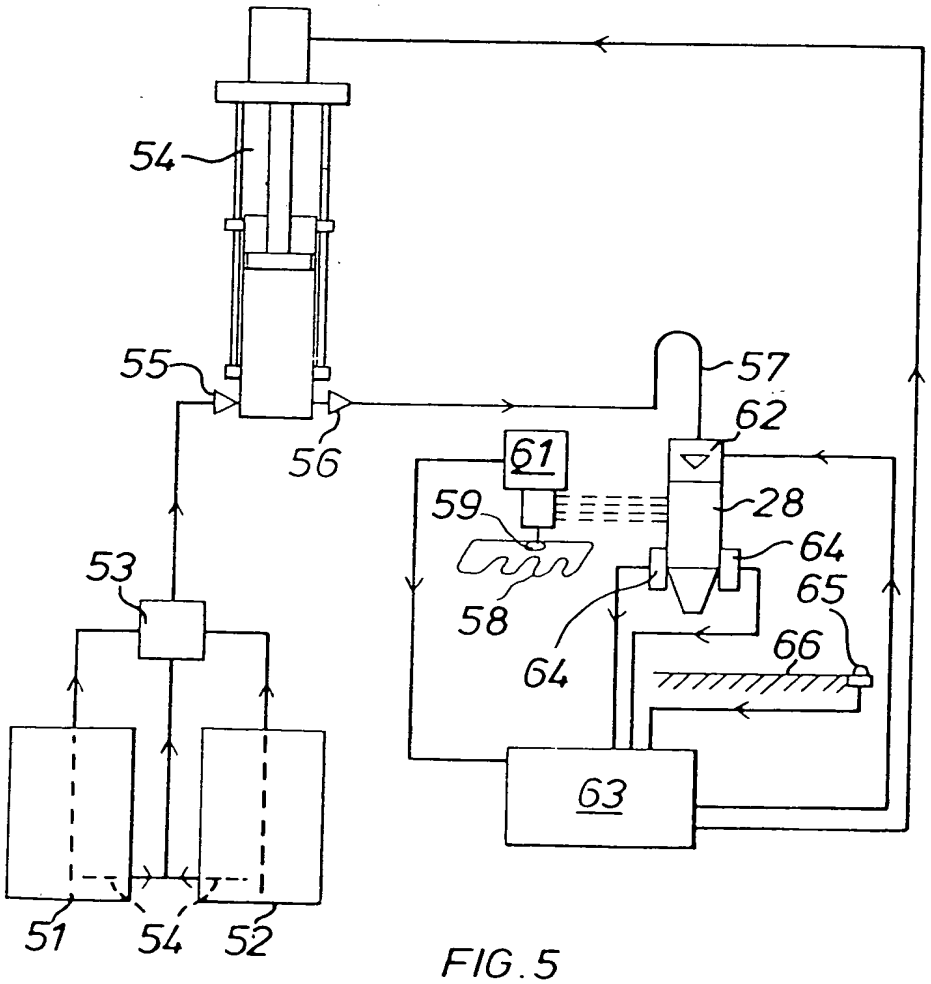
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FIG. 5

SPECIFICATION

Applying liquid gaskets to workpieces

This invention relates to the application of liquid gasket material to workpieces.

In place of conventional paper gaskets, manufacturers of internal combustion engines nowadays prefer to apply gasket material, such as air-curing silicone rubber, in liquid form. This has the advantage that leaky gaskets are virtually eliminated.

The gaskets are applied by a nozzle travelling around a required path, guided for example by a cam shaped to the requirements of the workpieces. The operation of the nozzle is controlled by a timer, which stops the movement of the nozzle and the flow of fluid therefrom after a given interval after a manual start. The interval is long enough for the nozzle to have travelled all the way around a closed loop path—typical of gaskets—and, to make sure the seal is complete, an overlap is allowed.

The gasket material is applied as a thin line to the face of the workpiece—for example, a cylinder block of an internal combustion engine. When the correponding closure part—for example, the cylinder head—is mated up, the gasket material spreads out into a film as the two surfaces are forced together.

We have found that there are disadvantages with this method of application.

In the first place, because of the overlap aforementioned, the nozzle begins its travel around successive workpieces at a different place, namely where it stopped on the previous workpiece. At some times, therefore, the nozzle may be inconveniently positioned for the removal of a finished workpiece and the insertion of a fresh one.

Then, where the overlap occurs, there is, of course, twice as much gasket material as elsewhere. Some parts of the workpiece may have relatively thin walls, so that the extra material in the overlap, when it occurs there—as it will inevitably by virtue of the progression of the starting and stopping points of the nozzle around the required path—may be forced out of the space between the mating parts. This could cause an obstruction in some of the coolant or lubricant passages through a cylinder block, for example.

This problem is solved, according to the present invention by controlling the operation of the nozzle by sensing means sensing the workpiece.

The sensing means—which may comprise photoelectric or capacitance devices, for example—may be connected to control the flow of material from the nozzle and/or the motion of the nozzle.

In one arrangement according to the invention, for applying a simple closed loop gasket to a cylinder block, the nozzle is guided over the cylinder block along the required path by a cam follower following a cam cut to suit the particular cylinder head. The flow of liquid and the motion of the nozzle around the path are started manually by pressing a start button when the cylinder head has been correctly positioned. A sensor travels with and slightly ahead of the nozzle and, when it senses previously applied gasket mateial—at the start position of the closed loop—it automatically cuts off the flow and stops the motion so that (either through a built-in delay or simply by virtue of the inertia of the system) there is a small overlap.

An interlock may be arranged so that once the motion has been stopped automatically at the completion of a gasket applying operation, further operation is precluded until the workpiece has been removed and a fresh one substituted. A reversing switch also changes the direction in which the nozzle moves around the required path. This has the effect that each operation starts where the previous operation finished and finishes where the previous operation started. So the overlaps of gasket material are always in the same position on the workpieces—and it can thus be arranged that they occur where the wall thickness is such that gasket material is not expressed from between the mating surfaces on subsequent compression.

Moreover, the nozzle can also be arranged to start and stop always at the edge of the work location so as not to interfere, when stopped, with the loading and unloading of the workpieces.

In another arrangement, for more complicated, workpieces where two or more discrete gasket loops are required, the nozzle is guided as before by a cam (albeit now a more complicated cam) and the motion is started manually. However, another sensor is provided to detect an edge or other feature—perhaps a previously applied mark—of the workpiece and to turn on the flow of gasket material when the nozzle is correctly positioned with respect to such feature. The flow can be turned off again by another sensor sensing another feature (or the same feature, perhaps) or sensing the previously applied gasket material at the start of a sub-loop of the looped path. The motion is uninterruped during traversing of the nozzle around the complete path, but the flow is started and stopped as many times as desired to apply the gasket material. Of course, in this case, the motion can be started and stopped at a single point, which may not be a point at which gasket material is being applied, and there may be no need to reverse the direction of motion around the path for successive workpieces.

Various other improvements may be incorporated. The flow of gasket material from the nozzle may be made very uniform, for exam-

ple, by the use of a novel pumping arrangement in which a piston-in-cylinder pump is provided which has a single stroke capacity greater than the maximum requirement of gasket material for a single workpiece. Between workpieces the pump is arranged to revert to the start of its stroke and recharge itself, so that a constant pressure or rate of feed is applied throughout the gasket forming operation, and this is the same for all gaskets. Differences in rates of feed from upstroke and downstroke of the piston are eliminated if only the downstroke (or only the upstroke) is used. The result is a very even application of the gaket material, which improves the quality of the gaskets and reduces wastage of the material.

To avoid machine downtime when a supply of gasket material runs out, a reserve supply is connectible by a change over switch actuated by a level sensor in the supply drum. The exhausted drum is replaced while the apparatus continues to operate on the reserve.

Embodiments of apparatus and methods for applying liquid gaskets according to the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a plan view of a workpiece with liquid gasket material applied to it,

Figure 2 is a diagrammatic plan view of a nozzle guiding arrangement,

Figure 3 is a perspective view of a nozzle arrangement,

Figure 4 is a plan view of another workpiece, and

Figure 5 is a diagrammatic illustration of a complete gasket applying system.

The workpiece 11 shown in Fig. 1 comprises a manifold side wall 12 having a part 13 with a relatively thick wall section as compared to the remainder. The gasket material is applied, according to the present invention, as a thin line in a closed loop 14 with an overlap 15 in the part 13 having the thicker section.

The arrangement shown in Fig. 2 for guiding the nozzle around a path such as to deposit the gasket material in the shape 14 comprises a cam follower 21 driven by a motor (not shown) that is mounted on a support 22 carried on anti-friction bearings 23 on slides 24 themselves mounted in supports 25 carried on further anti-friction bearings 26 on slides 27 arranged at right angles to the slides 24. The nozzle 28 is on a cantilever support arrangement 29 carried on the support 22. A cam 31 is arranged beneath the support 22, provision being made for its ready substitution with a differently shaped cam suited to a different workpiece. The nozzle 28 is therefore capable of being moved over a work location 32 in any closed loop configuration dictated by the cam shape currently installed. Preferably, the cam is made of a magnetic material and the cam follower is magnetically held thereagainst for accurate following. Of course, any other method of guidance could be used instead, for example, a photoelectric device following a line traced on a template, or the nozzle path could be controlled numerically.

It will be noticed that when the nozzle is at the extreme right hand end of the work location, as seen in Fig. 2, the cantilever support leaves the entire work location free for the easy exchange of workpieces.

Figure 3 shows the nozzle arrangement in perspective with a workpiece 33 positioned in a jig 34 on a work table 35. In this case the workpiece shown is very simple—it might be a rocker box cover, for example, for which the nozzle is made to describe a simple rectangular path as shown by the dashed line. Capacitance sensors 36 are arranged either side of the nozzle 28, and are connected to control means (not shown) adapted to cut off the flow from the nozzle and stop its motion when both the sensors detect the presence of gasket material on the workpiece. It is arranged, either by suitably positioning the sensors 36 with regard to the nozzle 28, or by building in a suitable delay in the control means, that the nozzle 28 stops moving and the flow is cut off when a small overlap has been made. A reversing switch then reverses the direction of traversing the path for the next workpiece. In this way the nozzle 28 always begins its run from one end of the overlap and finishes at the other so as to leave the work location free for the exchange of workpieces. The overlap region, moreover, is always exactly the same place on each workpiece, and it may be arranged, as shown, to be in a relatively thicker wall section of the workpiece so that the gasket material is not expressed from the edges when the mating component is clamped in.

Fig. 4 shows a more complicated workpiece in plan view. The gasket material is required to be placed in four rings 41, 42, 43, 44 around apertures 45 and in lines between the rings and from the edges of the faces 46 to each ring. The path of the nozzle, controlled by cam means not shown, is indicated by the dashed line. The sensors are arranged to initiate the flow as the nozzle crosses edges A and C, and to cut off the flow as the nozzle crosses edges B and D, with the direction of motion of the nozzle around the path indicated by the arrow. With such an arrangement, there will be laid a double line of gasket material around parts of each of the rings 41, 42, 43, 44. If this is not desired it could be eliminated by other sensor means cutting off the flow, as previously, also when gasket material was detected beneath the nozzle.

Fig. 5 shows, diagrammatically, a complete gasket applying system. Air-curing silicone rubber gasket material is supplied from operating and reserve tanks 51, 52 (which may,

of course, be identical, and may be the drums in which the manufacturers supply the material) via a change over valve 53 actuated by level sensors 54 connected to each tank so as to switch from an emptying tank to a full one. Preferably, also, the actuation of the change over valve 53 illuminates a lamp or gives another signal to warn that the empty tank needs replacement.

The material is drawn from the operating tank on the upstroke of a piston-in-cylinder pump 54 through a non-return valve 55, and expressed from the cylinder through another non-return valve 56 and flexible hose 57 to the nozzle 28. The nozzle is of course traversed around a required path specified by a cam 58, whose follower 59 is driven by an electric motor 61. The motor 61, the pump 54 and a solenoid valve 62 on the nozzle (for fast cut-off of gasket material) are controlled from a control arrangement 63 to which signals are input from sensors 64 carried with the nozzle 28. The control arrangement 63 contains a reversing switch to reverse the direction of traverse of the cam follower 59 if required, and an interlock actuated by a microswitch 65 on the work table 66 to prevent double actuation, that is to say to ensure that the system is inoperative after a single traverse until the microswitch has been released and reengaged by a fresh workpiece.

Between workpieces, the pump is operated to recharge the cylinder, which is arranged to have a larger capacity than the maximum amount of material that would be consumed for a single workpiece, so that it is always operating on its downstroke and hence at constant pressure.

The system provides a very flexible means of applying gasket material to workpieces of any configuration, requiring only a suitable cam or other guidance means and suitable selection, positioning and logic for the sensors. The equipment can be made very robust, and is suitable for long production runs, even for automatic loading of workpieces.

CLAIMS

1. A method for applying liquid gaskets to a succession of workpieces, in which gasket material is extruded from a nozzle guided over a required path over a work location served with the workpieces, characterised in that the operation of the nozzle is controlled by sensing means sensing the workpiece.

2. A method according to claim 1, characterised in that the sensing means control the flow of material from the nozzle.

3. A method according to claim 1, characterised in that the sensing means control the motion of the nozzle.

4. A method according to claim 1, characterised in that the sensing means sense the presence beneath the nozzle of previously applied gasket material.

5. A method according to claim 1, characterised in that the sensing means sense the presence beneath the nozzle of an edge of the workpiece.

6. A method according to claim 4, characterised in that the nozzle is guided around the required path in opposite directions on successive workpieces.

7. A method according to claim 1, characterised in that the control of the configuration of the required path is independent of the control of the operation of the nozzle.

8. A method according to claim 1, characterised in that the flow of material from the nozzle occurs at discrete parts of a closed loop path of the nozzle around a workpiece.

9. A method according to claim 8, characterised in that the flow of material from the nozzle occurs in two or more separate closed loops within a closed loop path of the nozzle around a workpiece.

10. Apparatus for applying liquid gaskets to a succession of workpieces comprising a nozzle mounted so as to be guidable over a required path over a work location that can be served with the workpieces, characterised by sensing means for the workpiece adapted to control the operation of the nozzle.

11. Apparatus according to claim 10, characterised in that the sensing means are adapted to stop the travel of the nozzle and the flow of material from the nozzle on sensing the presence beneath the nozzle of previously applied gasket material.

12. Apparatus according to claim 10, characterised in that the sensing means are adapted to initiate the flow of material from the nozzle on sensing the presence beneath the nozzle of an edge of the workpiece.

13. Apparatus according to claim 11, characterised by means reversing the direction of travel of the nozzle for successive workpieces.

14. Apparatus according to claim 10, characterised by means controlling the configuration of the required path independently of the control of the operation of the nozzle.

15. Apparatus according to claim 10, characterised by piston-in-cylinder pump means supplying gasket material to the nozzle, the capacity of the cyclinder exceeding the amount of gasket material to be fed to each workpiece, and means returning the piston to the same end position in the cylinder between successive workpieces.

16. Apparatus according to claim 10, characterised by having connections to two containers of gasket material and a changeover switch actuated by low level detecting means.

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